General

Guideline Title

Perioperative management of antithrombotic therapy: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines.

Bibliographic Source(s)

Douketis JD, Spyropoulos AC, Spencer FA, Mayr M, Jaffer AK, Eckman MH, Dunn AS, Kunz R. Perioperative management of antithrombotic therapy: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest. 2012 Feb;141(2 Suppl):e326S-50S. [219 references] PubMed

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Douketis JD, Berger PB, Dunn AS, Jaffer AK, Spyropoulos AC, Becker RC, Ansell J. The perioperative management of antithrombotic therapy: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). Chest 2008 Jun;133(6 Suppl):299S-339S. [237 references]

Recommendations

Major Recommendations

The grades of recommendation (1A, 1B, 1C, 2A, 2B, 2C) and the approach to rating the quality of evidence are defined at the end of the "Major Recommendations" field.

Perioperative Management of Patients Who Are Receiving Vitamin-K Antagonist (VKA) Therapy

Interruption of VKAs before Surgery

In patients who require temporary interruption of a VKA before surgery, the expert panel recommends stopping VKAs approximately 5 days before surgery *instead of* stopping VKAs a shorter time before surgery (Grade 1C).

Resumption of VKAs after Surgery

In patients who require temporary interruption of a VKA before surgery, the expert panel recommend resuming VKAs approximately 12 to 24 h after surgery (evening of or next morning) and when there is adequate hemostasis instead of later resumption of VKAs (Grade 2C).

Need for Bridging Anticoagulation During Interruption of VKA Therapy

In patients with a mechanical heart valve, atrial fibrillation, or venous thromboembolism (VTE) at high risk for thromboembolism, the expert panel

suggests bridging anticoagulation *instead of* no bridging during interruption of VKA therapy (Grade 2C).

Remarks: Patients who place a higher value on avoiding perioperative bleeding than on avoiding perioperative thromboembolism are likely to decline heparin bridging.

In patients with a mechanical heart valve, atrial fibrillation, or VTE at low risk for thromboembolism, the expert panel suggests no bridging instead of bridging anticoagulation during interruption of VKA therapy (Grade 2C).

In patients with a mechanical heart valve, atrial fibrillation, or VTE at moderate risk for thromboembolism, the bridging or no-bridging approach chosen is, as in the higher- and lower-risk patients, based on an assessment of individual patient- and surgery-related factors.

Perioperative Management of VKA-Treated Patients Who Require Minor Procedures

In patients who require a minor dental procedure, the expert panel suggests continuing VKAs with coadministration of an oral prohemostatic agent or stopping VKAs 2 to 3 days before the procedure *instead of* alternative strategies (Grade 2C). In patients who require minor dermatologic procedures and are receiving VKA therapy, the expert panel suggests continuing VKAs around the time of the procedure and optimizing local hemostasis *instead of* other strategies (Grade 2C). In patients who require cataract surgery and are receiving VKA therapy, the expert panel suggests continuing VKAs around the time of the surgery *instead of* other strategies (Grade 2C).

Perioperative Management of Patients Who Are Receiving Antiplatelet Drugs

Patients Having a Minor Dental, Dermatologic, or Ophthalmologic Procedure

In patients who are receiving acetylsalicylic acid (ASA) for the secondary prevention of cardiovascular disease and are having minor dental or dermatologic procedures or cataract surgery, the expert panel suggests continuing ASA around the time of the procedure *instead of* stopping ASA 7 to 10 days before the procedure (Grade 2C).

Patients Having Noncardiac Surgery

In patients at moderate to high risk for cardiovascular events who are receiving ASA therapy and require noncardiac surgery, the expert panel suggests continuing ASA around the time of surgery *instead of* stopping ASA 7 to 10 days before surgery (Grade 2C). In patients at low risk for cardiovascular events who are receiving ASA therapy, the expert panel suggest stopping ASA 7 to 10 days before surgery *instead of* continuation of ASA (Grade 2C).

Patients Having Coronary Artery Bypass Graft (CABG) Surgery

In patients who are receiving ASA and require CABG surgery, the expert panel suggests continuing ASA around the time of surgery *instead of* stopping ASA 7 to 10 days before surgery (Grade 2C). In patients who are receiving dual antiplatelet drug therapy and require CABG surgery, the expert panel suggests continuing ASA around the time of surgery and stopping clopidogrel/prasugrel 5 days before surgery *instead of* continuing dual antiplatelet therapy around the time of surgery (Grade 2C).

Patients with Coronary Stents Having Surgery

In patients with a coronary stent who are receiving dual antiplatelet therapy and require surgery, the expert panel recommends deferring surgery for at least 6 weeks after placement of a bare-metal stent and for at least 6 months after placement of a drug-eluting stent *instead of* undertaking surgery within these time periods (Grade 1C). In patients who require surgery within 6 weeks of placement of a bare-metal stent or within 6 months of placement of a drug-eluting stent, the expert panel suggests continuing dual antiplatelet therapy around the time of surgery *instead of* stopping dual antiplatelet therapy 7 to 10 days before surgery (Grade 2C).

Remarks: Patients who are more concerned about avoiding the unknown, but potentially large increase in bleeding risk associated with the perioperative continuation of dual antiplatelet therapy than avoiding the risk for coronary stent thrombosis are unlikely to choose continuation of dual antiplatelet therapy.

Perioperative Management of Patients Who Are Receiving Heparin Bridging Anticoagulation

Perioperative Use of IV UFH

In patients who are receiving bridging anticoagulation with therapeutic-dose IV UFH, the expert panel suggests stopping UFH 4 to 6 h before surgery *instead of* closer to surgery (Grade 2C).

Preoperative Interruption of Therapeutic-Dose Bridging LMWH

In patients who are receiving bridging anticoagulation with therapeutic-dose SC LMWH, the expert panel suggests administering the last preoperative dose of LMWH approximately 24 h before surgery *instead of* 12 hour before surgery (Grade 2C).

Postoperative Resumption of Therapeutic-Dose Bridging LMWH

In patients who are receiving bridging anticoagulation with therapeutic-dose SC LMWH and are undergoing high-bleeding-risk surgery, the expert panel suggests resuming therapeutic-dose LMWH 48 to 72 h after surgery *instead of* resuming LMWH within 24 hour after surgery (Grade 2C). In patients who are receiving bridging anticoagulation with therapeutic-dose SC LMWH and are undergoing non-high-bleeding-risk surgery, the expert panel suggests resuming therapeutic-dose LMWH approximately 24 h after surgery *instead of* resuming LMWH more than 24 h after surgery.

Definitions:

Grading of Recommendations Assessment, Development and Evaluation (GRADE) Approach to Rating Quality of Evidence

Study Design	Quality of Evidence	Lower if	Higher if
Randomized Trial →	High	Risk of bias -1 Serious -2 Very serious Inconsistency -1 Serious -2 Very serious Indirectness -1 Serious -2 Very serious Imprecision -1 Serious -2 Very serious Publication bias -1 Likely -2 Very likely	Large effect +1 Large +2 Very large Dose response +1 Evidence of a gradient All plausible confounding +1 Would produce a demonstrated effect or +1 Would suggest a spurious effect when result show no effect
	Moderate		
Observational Study →	Low		
	Very Low		

Strength of the Recommendations Grading System

Grade of Recommendation*	Benefit vs. Risk and Burdens	Methodologic Quality of Supporting Evidence	Implications
Strong recommendation, high-quality evidence, Grade 1A	Benefits clearly outweigh risk and burdens or vice versa	Consistent evidence from randomized controlled trials (RCTs) without important limitations or exceptionally strong evidence from observational studies	Recommendation can apply to most patients in most circumstances. Further research is very unlikely to change confidence in the estimate of effect
Strong recommendation, moderate-quality evidence, Grade 1B	Benefits clearly outweigh risk and burdens or vice versa	Evidence from RCTs with important limitations (inconsistent results, methodologic flaws, indirect or imprecise), or very strong evidence from observational studies	Recommendation can apply to most patients in most circumstances. Higher quality research may well have an important impact on confidence in the estimate of effect and may change the estimate
Strong recommendation, low- or very-low-quality evidence, Grade 1C	Benefits clearly outweigh risk and burdens or vice versa	Evidence for at least one critical outcome from observational studies, case series, or from RCTs with serious flaws or indirect evidence	Recommendation can apply to most patients in many circumstances. Higher-quality research is likely to have an important impact on confidence in the estimate of effect and may well change the estimate
Weak recommendation, high-quality evidence, Grade 2A	Benefits closely balanced with risks and burden	Consistent evidence from RCTs without important limitations or exceptionally strong evidence from observational studies	The best action may differ depending on circumstances or patient or society values. Further research is very unlikely to change confidence in the estimate of effect

Grade of Recommendation*	Benefit vs. Risk and Burden	Methodologic Quality of Supporting Evidence	Implications
Weak recommendation, moderate-quality evidence, Grade 2B	Benefits closely balanced with risks and burden	Evidence from RCTs with important limitations (inconsistent results, methodologic flaws, indirect or imprecise) or very strong evidence from observational studies	Best action may differ depending on circumstances or patient or society values. Higher-quality research may well have an important impact on confidence in the estimate of effect and may change the estimate
Weak recommendation, low- or very-low-quality evidence, Grade 2C	Uncertainty in the estimates of benefits, risks, and burden; benefits, risk, and burden may be closely balanced	Evidence for at least one critical outcome from observational studies, case series, or RCTs, with serious flaws or indirect evidence	Other alternatives may be equally reasonable. Higher-quality research is likely to have an important impact on confidence in the estimate of effect and may well change the estimate

*The guideline developers use the wording recommend for strong (Grade 1) recommendations and suggest for weak (Grade 2) recommendations.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Perioperative arterial and venous thromboembolism

Guideline Category

Management

Prevention

Risk Assessment

Treatment

Clinical Specialty

Anesthesiology

Cardiology

Critical Care

Dentistry

Emergency Medicine

Family Practice

Gastroenterology

Hematology

Internal Medicine

Neurology

Ophthalmology

Pulmonary Medicine

Surgery

Thoracic Surgery

Intended Users

Advanced Practice Nurses

Health Care Providers

Nurses

Patients

Pharmacists

Physician Assistants

Physicians

Guideline Objective(s)

- To update evidence-based recommendations for the use of anticoagulant therapy for the management of thromboembolic conditions
- To offer guidance for many common anticoagulation-related management problems
- To optimize patient-important health outcomes and the processes of care for patients who have experienced or are at risk for thrombotic events
- To provide guidelines for perioperative antithrombotic management that reflect the quality of the available evidence
- To provide guidance for clinicians as to the practical aspects of antithrombotic management in perioperative settings

Target Population

Patients who are receiving anticoagulant or antiplatelet therapy and require an elective surgery or procedure

Interventions and Practices Considered

1. Preoperative interruption of vitamin K antagonists (VKAs)
2. Postoperative resumption of VKAs
3. Bridging anticoagulation (subcutaneous low-molecular-weight heparin [SC LMWH], intravenous unfractionated heparin [IV UFH]) during interruption of VKA therapy
4. Perioperative management of VKA-treated patients requiring minor procedures
5. Perioperative management of patients who are receiving antiplatelet therapy (aspirin, clopidogrel)
    - Patients undergoing minor dental, dermatological, ophthalmological procedures
    - Patients having noncardiac surgery
    - Patients undergoing coronary bypass graft surgery
    - Patients with coronary stents
6. Postoperative resumption of antiplatelet therapy
7. Perioperative use of IV UFH
8. Preoperative interruption of therapeutic-dose bridging LMWH
9. Postoperative resumption of therapeutic-dose bridging LMWH

Major Outcomes Considered

- Hemostasis at time of surgery (international normalized ratio [INR], activated partial thromboplastin time [aPPT], antifactor Xa)
- Stroke, other systemic embolism, or major hemorrhage
- Arterial or venous thromboembolism
- Myocardial ischemia
- Postoperative bleeding

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

General Methods

Defining the Clinical Questions—Population, Intervention, Comparator, and Outcome

The thrombosis expert on the Executive Committee along with the deputy editors took primary responsibility for defining the scope of the clinical questions that each article would address. For each question, the topic editor and deputy editor defined the relevant population, alternative management strategies (intervention and comparator), and the outcomes (i.e., population, intervention, comparator, and outcome [PICO] format). Each clinical question provided the framework for formulating study inclusion and exclusion criteria and guided the search for relevant evidence (systematic reviews and original studies). Panels typically restricted included studies to randomized controlled trials (RCTs) for intervention questions but included observational studies when there was a paucity of RCT data addressing an intervention and for questions of risk assessment. Readers can find these PICO questions in the first table of each article. One or more recommendations could be formulated for each clinical question.

Identifying the Evidence

To identify the relevant evidence, a team of methodologists and medical librarians at the Oregon Health & Science University Evidence-based Practice Center conducted literature searches of Medline, the Cochrane Library, and the Database of Abstracts of Reviews of Effects. For each article, the team conducted a search for systematic reviews and another for original studies encompassing the main populations and interventions for that article. These searches included studies indexed from week 1, January 2005, forward because Antithrombotic and Thrombolytic Therapy: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines, 8th Edition (AT8) searches were carried out up to that date (search strategies are available on request). Many articles supplemented these searches with more-focused searches addressing specific clinical questions. When clinical questions had not been covered in AT8, searches commenced at a date relevant to each intervention.

Titles and abstracts retrieved from bibliographic database searches generally were screened in duplicate, and full-text articles were retrieved for further review. Consensus on whether individual studies fulfilled inclusion criteria was achieved for each study between two reviewers. If consensus could not be achieved, the topic editor and other topic panelists were brought into the discussion. Deputy editors reviewed lists of included studies from the database searches in order to identify any potentially missed studies. Additional studies identified were then retrieved for further evaluation.

Topic panels also searched the same bibliographic databases for systematic reviews addressing each PICO question. The quality of reviews was assessed using principles embodied in prior instruments addressing methodologic quality of systematic reviews, and wherever possible, current high-quality systematic reviews were used as the source of summary estimates. Reviews were also used to identify additional studies to complement the database searches.

Specific Methods for This Guideline

The Medline English-language database was searched from January 1970 to January 2010 using multiple keywords and standardized terminology, where applicable, as outlined in Appendix S1 of the original guideline document. This search was done in two parts. The ï¬rst was a systematic

review of the literature from 1970 to January 2007, which was used in AT8. The second search updated this search strategy to include studies up until January 2010. The panel supplemented these literature searches by conducting Internet-based searches of ClinicalTrials.gov, meeting abstracts, and conference proceedings. In addition, reference lists of studies that satisfied inclusion criteria were manually reviewed. Finally, content experts were contacted to identify additional studies that were not identified by these search strategies.

Number of Source Documents

Not stated

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Grading of Recommendations Assessment, Development and Evaluation (GRADE) Approach to Rating Quality of Evidence

Study Design	Quality of Evidence	Lower if	Higher if
Randomized Trial →	High	Risk of bias -1 Serious -2 Very serious Inconsistency -1 Serious -2 Very serious Indirectness -1 Serious -2 Very serious Imprecision -1 Serious -2 Very serious Publication bias -1 Likely -2 Very likely	Large effect +1 Large +2 Very large Dose response +1 Evidence of a gradient All plausible confounding +1 Would produce a demonstrated effect or +1 Would suggest a spurious effect when result show no effect
	Moderate		
Observational Study →	Low		
	Very Low		

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

General Methods

Assessing Studies and Summarizing Evidence

Evaluating Risk of Bias in Individual Studies

The expert panel developed and applied uniform criteria for evaluating the risk of bias associated with individual randomized controlled trials (RCTs) based on the criteria recommended by the Cochrane Collaboration (Table 1 in the methodology companion [see the "Availability of Companion Documents" field]). Although all authors assessed risk of bias for individual studies, because of resource limitations, the panel

summarized the results of the risk of bias for only a minority of the recommendations. Readers can find these assessments in the online data supplements. For most recommendations for which such tables were not developed, Evidence Profiles that typically provide information on the risk of bias in footnotes were developed.

The panel also developed specific criteria for assessing the risk of bias of observational studies (cohort studies with concurrent controls, cohort studies with historical controls, case-control studies, or case series). Again, these were based on the evidence-based domains recommended by the Cochrane Collaboration for observational studies.

Studies without internal comparisons were termed "cohort studies without internal controls" if they met the following criteria:

1. A protocol existed before the date of commencement of data collection.
2. A definition of inclusion and exclusion criteria was available.
3. The study reported the number of excluded patients.
4. The study conducted a standardized follow-up, including description of all of the following: schedule of follow-up, investigation of suspected outcomes, and criteria used to define outcomes.
5. The study reported all losses to follow-up.

The panel labeled studies that did not meet these criteria as "case series." No distinction was made between prospective and retrospective studies because although prospective studies may on average be of higher quality, individual prospective studies may have a significant risk of bias and specific retrospective studies may not. For questions related to risk assessment, the panel evaluated the risk of bias of individual studies using the following criteria: valid outcome assessment, including blinding when appropriate; adjustment for between-group differences; and minimal loss to follow-up.

Evaluating Quality of Bodies of Evidence

The expert panel assessed evidence across studies on an outcome-by-outcome basis using criteria suggested by the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group. The expert panel defined quality of evidence as their confidence in the estimate of the effect to support a recommendation. RCTs start as high-quality evidence and observational studies as low-quality evidence. Additional factors that affect this rating of quality include the risk of bias; precision, consistency, and directness of results; likelihood of publication bias; and presence of very large effects. The American College of Chest Physicians (ACCP) adaptation of the GRADE system differs only in that the quality of a body of evidence can be high (A), moderate (B), or low (C); GRADE also provides a category for very-low-quality evidence. See the "Rating Scheme for the Strength of the Evidence" field.

Often, the panel found that the quality of the evidence differed across outcomes. For example, in assessing the quality of evidence for thienopyridines vs warfarin in patients undergoing percutaneous coronary interventions, the panel determined the evidence to be of moderate quality for mortality, nonfatal myocardial infarction, and revascularization but of low quality for major bleeding.

The panel then made a rating of the quality of the entire body of evidence bearing on the effect of alternative management strategies for each clinical question. In other words, the panel assessed the quality across outcomes, including both benefits and harms. Quality for each recommendation was the lowest quality rating of the outcomes judged as critical (as opposed to important, but not critical).

Most patient-important outcomes in this guideline are binary or yes-no outcomes (death, stroke, venous thromboembolism [VTE], myocardial infarction, bleeding). In general, relative effects are similar across subgroups of patients, including those with varying baseline risk. The evidence summaries (Evidence Profiles and Summary of Findings tables), therefore, include a presentation of relative effects (where possible as relative risks because they are easier to understand than odds ratios [ORs]) of intervention vs control management strategies.

Trading off desirable and undesirable consequences (e.g., thrombosis vs bleeding) requires, however, estimates of absolute effect. For example, in patients with atrial fibrillation, warfarin results in a 66% relative risk reduction in nonfatal stroke. This comes at a cost of inconvenience, lifestyle restrictions, and risk of bleeding. For patients with a CHADS (congestive heart failure, hypertension, age ≥75 years, diabetes mellitus, stroke) score of ≥3, the 66% relative risk reduction translates into an absolute reduction of 6.3% (63 in 1,000) per year. Virtually all patients will consider this worthwhile. On the other hand, for patients with a CHADS score of 0, the 66% reduction translates into an absolute risk reduction of only 0.5% (5 in 1,000) per year. Many patients may consider this reduction not worth the undesirable consequences of warfarin use.

The panel calculated absolute effects by applying relative risks to estimates of control group risk. For instance, if control group risk of thrombosis is 4% and relative risk with an intervention is 50%, then the absolute difference between intervention and control is 4% of 50% or 2%, and the number needed to treat to prevent an episode of thrombosis is 100/2 or 50. In many cases, the Summary of Findings tables present effects as events prevented (or caused) per 1,000 patients. In this hypothetical example, the effect would be 20 events per 1,000 patients.

Whenever valid prognostic data were available from observational studies, they were used to estimate control group risks. When credible results

from observational and prognostic studies were not available, risk estimates from control groups of RCTs were used.

Considering Subgroup-Specific Relative and Absolute Effects

Whenever the expert panel identified credible evidence that the relative effects vary across distinguishable subgroups of patients (i.e., interaction between the intervention and a patient characteristic), the respective relative effects were considered separately. The panel then calculated the associated absolute effects.

Even when the relative effect is the same, the absolute magnitude of treatment effects may differ in patients with varying levels of risk. For instance, although the relative risk reduction of warfarin vs aspirin in stroke prevention for patients with atrial fibrillation is likely close to 50% across risk groups, this translates into an absolute risk reduction of <1% per year in the lowest-risk groups and ~5% per year in the highest-risk groups.

The expert panel included control group risks and absolute-effect estimates for different groups in the summaries of effect when (and only when) two conditions were present. First, they required validated prognostic models or, at the very least, credible strategies for clinicians to easily identify higher- and lower-risk patients. Second, the panel identified varying risk groups only when recommendations differed in strength or direction between groups. Both conditions were met, for instance, in the atrial fibrillation recommendations in which strong recommendations in favor of anticoagulation were restricted to the higher-risk patients.

Conducting Meta-analyses

When pooled estimates of effects were not available from existing high-quality systematic reviews, the panel performed meta-analyses if the data were sufficiently homogeneous. When pooling two studies, they used a fixed-effects model. When three or more studies were available for generating a pooled estimate, they used a random-effects model as the primary analysis and a fixed-effects model as a secondary analysis. If there were discrepancies between the two, the panel considered the following reasons: If there was substantial heterogeneity leading to wider confidence intervals (CIs) with the random-effects model, the panel considered that model more trustworthy, and if the discrepancy was due to a single large dominant study with a result substantially different from smaller studies, they considered the fixed-effects model more trustworthy. The panel also assessed statistical heterogeneity using both a χ^2 test and I^2 as well as assessed possible explanations of heterogeneity considering a priori-generated hypotheses.

Summary Tables

When resources permitted, the expert panel used a standardized approach for summarizing the evidence and methodology of individual studies. These summaries appear in the online data supplements. Wherever possible, the expert panel reported nonfatal events (e.g., nonfatal stroke) so that there is no overlap with the number of fatal events reported.

For a large number of recommendations, the expert panel summarized the quality of the body of evidence (see the "Rating Scheme for the Strength of the Evidence" field) and estimates of relative and absolute effect of alternative management strategies using the methods of the GRADE Working Group. Evidence Profiles summarize the quality of the body of evidence and when evidence comes from randomized trials, generally include a presentation of reviewer assessment of risk of bias, precision, consistency, directness, and publication bias associated with each outcome. As specified in GRADE methodology, the overall quality of evidence represents the lowest quality of any critical outcome.

Evidence Profiles can be found in the online data supplement. The format for these tables was determined through a formal survey of panelists that evaluated the panelists' preferences for alternative presentations and the impact of these presentations on their understanding of the evidence. The text in the printed version of Antithrombotic Therapy and Prevention of Thrombosis, 9th ed (AT9) recommendations includes more succinct Summary of Findings tables, which include the overall quality assessment as well as the relative and absolute effect sizes for each outcome. Use of an associated computer program facilitated the production of the Evidence Profiles and Summary of Findings tables which are listed in the original guideline document.

Specific Methods for This Guideline

The recommendations in this article were developed in accordance with the methodologic changes in AT9 based on evidence profiles and summary of findings tables that followed the GRADE system format.

For the section on the perioperative management of vitamin K antagonist (VKA) therapy, the panel developed evidence profiles to formulate recommendations for the prespecified population, intervention, comparator, and outcome (PICO) questions. These evidence profiles include studies directly pertinent to the PICO questions. The recommendations were based on studies in the evidence profile that provided data specific to the perioperative clinical setting. In cases where there also were relevant studies from the nonperioperative setting, which were not part of the evidence profile because they provided indirect data, these studies also had a bearing on the recommendations.

For the section on the perioperative management of antiplatelet therapy, evidence profiles were not produced in part because there were insufficient studies to develop profiles specific to the prespecified PICO questions. The panel produced summary of findings tables of all pertinent (but often indirect) data. The recommendations provided were based on the studies in these summary of findings tables, which are available in the online data supplement. As with the perioperative VKA management sections, additional studies may have been referenced in the narrative, but the recommendations were based entirely on studies in the summary of findings tables.

Methods Used to Formulate the Recommendations

Expert Consensus (Consensus Development Conference)

Description of Methods Used to Formulate the Recommendations

General Methods

Composition and Selection of Topic Panel Members

The American College of Chest Physicians (ACCP) Antithrombotic Therapy and Prevention of Thrombosis, 9th ed (AT9) Executive Committee selected panel members for each article. A topic editor and a deputy editor led each of the AT9 panels issuing recommendations. The topic editor was the person primarily responsible for each article and was required to be a methodologist without serious financial or intellectual conflict of interest for any of the article's recommendations. In all but one case, the topic editor also was a clinician. The Executive Committee chose these individuals on the basis of their previous experience with guideline development and, in particular, their familiarity with methods developed by the Grading of Recommendation, Assessment, Development, and Evaluation (GRADE) Working Group. These topic editors and all panel members were approved by the ACCP Health and Science Policy (HSP) Committee after review of their conflict of interest disclosures.

Criteria for selection of the remainder of the panel members, including the deputy editor-thrombosis expert, were an established record in the relevant clinical or research area, international and gender representation, and an absence of financial conflicts of interest that were judged unacceptable. Some of the panelists had prior experience on ACCP guidelines in this area and represented the thrombosis community, but there was substantial turnover from the previous edition. After an international request for applications broadcast through multiple medical societies, the Executive Committee nominated individual topic editors and deputy editors and collaborated with them to identify and nominate other topic panel members.

The ACCP HSP Committee reviewed all nominees and approved all panel members after review of their curricula vitae and conflict of interest disclosures. Of 150 nominees, 137 were approved, 18 were approved with management of conflicts of interest (i.e., regular disclosures and review of ongoing conflicts as the process progressed), and 13 were disapproved as a result of the magnitude of financial conflicts of interest. Articles associated with recommendations included from seven to 14 panel members. Patients or representatives of specific stakeholder groups were not included on topic panels.

Each topic panel also included a frontline physician working in the relevant area who was neither an expert in thrombosis nor a methodologist or clinical investigator. These individuals were chosen in consultation with the topic editors and the ACCP HSP Committee. These clinicians were charged with the following: (1) proposing important real-world clinical questions on the prevention, diagnosis, and treatment of thrombosis that were not addressed in Antithrombotic and Thrombolytic Therapy: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines, 8th Edition (AT8) and (2) reviewing the draft manuscripts and recommendations to assess the usability of the guidelines and the feasibility of implementation of AT9 recommendations.

To address issues of economic efficiency six health economist-physicians were included on the AT9 topic panels charged with making recommendations. These resource consultants were selected and approved through identical procedures to those for topic editors and panel members.

Ensuring Consistency Across Articles

A number of strategies were used to ensure consistency across articles, and one panel member participated extensively in the formulation of clinical questions for each article. To ensure consistency of judgments regarding bleeding, another panel member was responsible for standardizing the approach to bleeding outcomes and participated in multiple topic panels. Additionally, to ensure consistency in the trade-offs between thrombotic and bleeding events, all articles used the same ratings of values and preferences (described in more detail in the methodology companion [see the "Availability of Companion Documents" field]). Because some of the same evidence summaries were relevant to several articles, five individuals were chosen to participate in each of the articles addressing coronary artery disease, stroke, and peripheral arterial disease.

In AT9, prevention of venous thromboembolism (VTE) is addressed in three articles as opposed to a single article as was done in AT8. The prevention topic editors and deputy editors and those of the stroke article (which includes thromboprophylaxis recommendations) participated in multiple conference calls to develop and harmonize the approach to prevention and to ensure consistency among final recommendations. Topic editors consulted with one another when issues overlapped. For example, the decision regarding the use of a vitamin K antagonist, aspirin, and clopidogrel simultaneously in patients with atrial fibrillation, valvular disease, and intravascular stents is relevant for the atrial fibrillation, coronary, and peripheral arterial disease articles. Topic panels deferred to the Evidence-Based Management of Anticoagulant Therapy AT9 topic panel for recommendations related to the dosing and monitoring of anticoagulation therapies.

The AT9 Executive Committee met at least once a month and regularly issued statements of clarification of methods to topic editors and deputy editors (e.g., use of fixed- or random-effects models for meta-analysis), conflict of interest, preparation of tables, and issues of style and presentation. All these statements were communicated directly to the topic editors and deputy editors and made available in a central repository accessible to all AT9 panelists. The chair of the Executive Committee was available for resolving any challenging issues related to the aforementioned topics. Between September 2009 and September 2010, two members of the Executive Committee held regular (every 3 months), separate conference calls with each topic editor and deputy editor during which they addressed questions and concerns. Finally, the chair of the Executive Committee reviewed every article to ensure consistency of evidence presentation, evaluation, and writing style. Refer to the methodology companion for further information on the approach used to ensure consistent language in writing.

Formulating Recommendations

Following approaches recommended by the GRADE Working Group, the topic editor, in some cases aided by a panelist without conflicts, formulated the draft recommendations. The formulation of recommendations considered the balance between the desirable and undesirable consequences of an intervention; the quality of evidence; the variability in patient values and preferences; and, on occasion, resource use issues. The recommendations were graded as strong when desirable effects were much greater than undesirable effects or vice versa. Strong recommendations were worded as "The expert panel recommends" and labeled 1. Recommendations were graded as weak when desirable effects were not clearly greater or less great than undesirable effects. Weak recommendations were worded as "The expert panel suggests" and labeled 2. The rating of the quality of the evidence—high, A; moderate, B; or low, C—is provided with the strength of each recommendation.

Finalizing Recommendations

The topic panel members without primary conflicts discussed draft recommendations. Initial discussions generally led to a consensus at the article level on the quality of evidence and the direction and strength of recommendations. At least two members of the Executive Committee reviewed in detail drafts of articles, including recommendations. Written critiques were prepared and returned to the authors for revision. Articles were then made available to the entire AT9 panel.

Recommendations on which topic panels had difficulty coming to a consensus were discussed at a final conference in February 2011 attended by the topic editors and deputy editors and at least one other panel member from each article. Prior to the conference, all AT9 panelists updated their conflict of interest disclosures. The ACCP invited a number of clinical organizations with interest in the guideline topic to attend the final conference as observers.

At this final conference, a representative of each article presented potentially controversial issues in their article's recommendations. Following discussion, which included those present and those attending by video conference, all panelists without primary conflicts of interest voted on each recommendation. The voting process used a GRADE grid and required that for a strong recommendation, ≥80% of those voting had to agree that a strong recommendation was appropriate.

The AT9 Executive Committee members harmonized the articles and resolved remaining disagreements among them through facilitated discussion with topic editors and deputy editors without primary conflicts. All major correspondence and decisions at the final conference were recorded in written and audio formats and are available on request to science@chestnet.org.

See the methodology companion (see the "Availability of Companion Documents" field) for information on accounting for patient values and preferences in recommendations.

Specific Methods for this Guideline

Development of Chapter Recommendations and Narrative

The development of recommendations followed a prespecified process based on the following four steps: (1) developing population, intervention, comparator, and outcome (PICO) questions for clinical topics deemed important, which are summarized in Table 2 in the original guideline document; (2) identifying pertinent studies from AT8 supplemented by additional searches of more recent studies; (3) developing provisional recommendations and parallel development of a draft manuscript and revision of original PICO questions; and (4) developing final

recommendations by nonconflicted panelists. The development of article recommendations was guided by the topic editor, whereas the development of the article narrative was overseen by the deputy editor.

Rating Scheme for the Strength of the Recommendations

Strength of the Recommendations Grading System

Grade of Recommendation*	Benefit vs. Risk and Burdens	Methodologic Quality of Supporting Evidence	Implications
Strong recommendation, high-quality evidence, Grade 1A	Benefits clearly outweigh risk and burdens or vice versa	Consistent evidence from randomized controlled trials (RCTs) without important limitations or exceptionally strong evidence from observational studies	Recommendation can apply to most patients in most circumstances. Further research is very unlikely to change confidence in the estimate of effect
Strong recommendation, moderate-quality evidence, Grade 1B	Benefits clearly outweigh risk and burdens or vice versa	Evidence from RCTs with important limitations (inconsistent results, methodologic flaws, indirect or imprecise), or very strong evidence from observational studies	Recommendation can apply to most patients in most circumstances. Higher quality research may well have an important impact on confidence in the estimate of effect and may change the estimate
Strong recommendation, low- or very-low-quality evidence, Grade 1C	Benefits clearly outweigh risk and burdens or vice versa	Evidence for at least one critical outcome from observational studies, case series, or from RCTs with serious flaws or indirect evidence	Recommendation can apply to most patients in many circumstances. Higher-quality research is likely to have an important impact on confidence in the estimate of effect and may well change the estimate
Weak recommendation, high-quality evidence, Grade 2A	Benefits closely balanced with risks and burden	Consistent evidence from RCTs without important limitations or exceptionally strong evidence from observational studies	The best action may differ depending on circumstances or patient or society values. Further research is very unlikely to change confidence in the estimate of effect
Weak recommendation, moderate-quality evidence, Grade 2B	Benefits closely balanced with risks and burden	Evidence from RCTs with important limitations (inconsistent results, methodologic flaws, indirect or imprecise) or very strong evidence from observational studies	Best action may differ depending on circumstances or patient or society values. Higher-quality research may well have an important impact on confidence in the estimate of effect and may change the estimate
Weak recommendation, low- or very-low-quality evidence, Grade 2C	Uncertainty in the estimates of benefits, risks, and burden; benefits, risk, and burden may be closely balanced	Evidence for at least one critical outcome from observational studies, case series, or RCTs, with serious flaws or indirect evidence	Other alternatives may be equally reasonable. Higher-quality research is likely to have an important impact on confidence in the estimate of effect and may well change the estimate

*The guideline developers use the wording recommend for strong (Grade 1) recommendations and suggest for weak (Grade 2) recommendations.

Cost Analysis

General

Resource Use Issues

In addressing resource use (cost) issues in Antithrombotic Therapy and Prevention of Thrombosis, 9th ed (AT9), the expert panel followed previously developed principles. In particular, the panel restricted economic evaluation to recommendations in which it was plausible that resource use considerations might change the direction or strength of the recommendation and in which high-quality economic evaluations were available. When this was not the case, the panel did not consider resource use in the recommendations.

Six clinicians with the requisite expertise in decision and economic analyses participated in the guideline development process; each article had the benefit of one of these experts as a full committee member. The following subsections present key points in the process of considering resource allocation issues in the recommendations.

Overview of the Process

Panelists, in consultation with resource use consultants, determined questions for which resource use might change the direction or strength of recommendations. For those questions, the panel sought high-quality economic analyses. If such analyses were available, the panel applied the evidence regarding resource use to the relevant recommendation. If net costs or marginal cost-effectiveness ratios were very high, panelists considered rating down the quality of evidence for an intervention from high to low or possibly changing the direction of the recommendation using guides described in the section "Criteria for Resource Allocation Issues to Affect Recommendations—Thresholds for Cost-Effectiveness" in the methodology companion (see the "Availability of Companion Documents" field).

Identifying the Literature

The Oregon Health & Science University Evidence-based Practice Center conducted thorough literature searches for economic analyses relevant to the different AT9 articles. The resource use experts supplemented these by searches focused on the specific questions of interest for each article. The searches were conducted in Medline and the Cochrane Central Register of Clinical Trials. On the basis that data from studies appreciably more than a decade old would not reflect the current situation, searches were restricted to published studies from 1999 forward. Thus, bibliographic database searches encompassed publications from January 1999 forward: The end date varied across articles and ranged between November 2009 and March 2010 when the searches were executed.

Evaluating the Evidence

A standardized data extraction form was used to ensure uniform evaluation of the quality of relevant economic analyses. Quality assessment was based on published criteria and included specification of perspective of analysis (e.g., societal, health system), appropriateness of time horizon (preferably lifetime), use of high-quality evidence for probabilities and rates, use of high-quality sources for costs (e.g., primary data, Medicare payments, claims data as proxies), use of appropriate methods for measurement of preferences, and performance of sensitivity analyses to explore uncertainty (both deterministic and probabilistic).

Criteria for Resource Allocation Issues to Affect Recommendations—Thresholds for Cost-Effectiveness

The results of economic analyses may either increase the strength of an otherwise weak recommendation or weaken the strength of a strong recommendation. If cost-effectiveness studies bolstered an already strong recommendation, no change to the recommendation was necessary. The panel chose the following thresholds for cost-effectiveness considerations affecting recommendations:

1. When the clinical evidence warrants a strong recommendation for A over B:
    a. Strong recommendation favoring A when high-quality evidence from economic evaluations shows that A costs <3 times the gross domestic product (GDP) per capita (approximately US $150,000) per quality-adjusted life year (QALY) gained relative to B
    b. Weak recommendation favoring A when high-quality evidence from economic evaluations shows that A costs 3 to 5 times the GDP per capita (~$150,000-$250,000) per QALY gained relative to B
    c. Weak recommendation favoring B when high-quality evidence from economic evaluations shows that A costs >5 times the GDP per capita (~$250,000) per QALY gained relative to B
2. When the clinical evidence warrants a weak recommendation for A over B:
    a. Strong recommendation favoring A if A results in cost savings of >10% to 20% of the GDP per capita (~$5,000-$10,000) relative to B (Cost savings must represent all downstream costs and not just the actual cost of the intervention, and analysis must demonstrate a high level of confidence that there is a cost savings.)
    b. Continued weak recommendation favoring A when B is marginally more costly than A (<10% the GDP per capita)
    c. Continued weak recommendation favoring A when A costs 0 to 5 times the GDP per capita per QALY gained relative to B
    d. Weak recommendation favoring B if A costs >5 times the GDP per capita (~$250,000) per QALY gained relative to B

Extension of Economic Analyses to Low- and Middle-Income Countries

Although certain interventions may be cost-effective in high-income countries (e.g., <$20,000 per QALY gained), in poor countries, $20,000 gained per QALY may be prohibitive. The choice of a threshold will vary depending on who is making resource allocation decisions. To facilitate the use of already published cost-effectiveness analyses, the World Health Organization (WHO), through its WHO-CHOICE (Choosing Interventions that are Cost Effective) program has used criteria suggested by the Commission on Macroeconomics and Health. Interventions that cost <1 times the average per-capita income for a given country or region per QALY gained are considered very cost-effective. Interventions that cost up to three times the average per-capita income per QALY gained are still considered cost-effective, whereas those that exceed this level are not considered to be cost-effective. To facilitate this process, WHO has developed tables of such threshold values for different regions and countries around the world. Thus, the thresholds discussed in the previous section have been defined in terms of GDP per capita. Although referencing thresholds for cost-effectiveness to average per-capita income in middle- and low-income countries can help to extend results of

economic analyses performed in high-income countries, such analyses may be less relevant in low-income countries because of significantly different material and labor costs and, thus, may be difficult to extrapolate. Furthermore, the comparator strategies may not be feasible or customary in these locales.

Specific to This Guideline

Cost-effectiveness of Perioperative Management Strategies

The cost-effectiveness of bridging anticoagulation has been assessed using various decision analysis models. These studies suggest that for patients other than those at highest risk for stroke and arterial thromboembolism (ATE), bridging anticoagulation is unnecessary. In patients undergoing minor dental procedures, decision analyses have suggested that continuation of vitamin K antagonist (VKA) therapy is less expensive than VKA interruption with bridging therapy. Studies of gastrointestinal (GI) endoscopy have been consistent with American Society of Gastroenterology Guidelines, suggesting that continuing VKA therapy in patients having procedures associated with a low bleeding risk (e.g., diagnostic endoscopy without biopsy) is less expensive than bridging, whereas discontinuation of VKA therapy without bridging is more cost-effective in patients at low thromboembolic risk who are undergoing high-bleeding-risk procedures. Prospective cohort studies have compared the costs of bridging anticoagulation with either in-hospital intravenous (IV) unfractionated heparin (UFH) or out-of-hospital subcutaneous (SC) low-molecular-weight heparin (LMWH). In one study comparing patient-administered SC LMWH, nurse-administered SC LWMH, and in-hospital IV UFH, the anticoagulant-related costs for patients having surgery with an overnight hospital stay were estimated at US $672, $933, and $3,916, respectively. Another cohort study comparing costs in 26 patients who received in-hospital IV UFH and 40 patients who received out-of-hospital SC LMWH and had elective surgery found a significantly lower mean total health-care cost (by $13,114) in patients who received perioperative LMWH. Taken together, these findings lead to questions about the need for bridging therapy in patients not considered at high risk for ATE. Furthermore, these studies confirm considerable cost savings with the use of SC LMWHs instead of IV UFH, which can be given in an outpatient setting by the patient or a family member in >90% of cases.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

The American College of Chest Physicians (ACCP) Health and Science Policy (HSP) Committee established a process for the thorough review of all ACCP evidence-based clinical practice guidelines. After final review by the Antithrombotic Therapy and Prevention of Thrombosis, 9th ed (AT9) Executive Committee, the guidelines underwent review by the Cardiovascular and Pulmonary Vascular NetWorks of the ACCP, the HSP Committee, and the ACCP Board of Regents. The latter two groups had the right of approval or disapproval but usually worked with the topic panelists and editors to make necessary revisions prior to final approval. Both the HSP Committee and the Board of Regents identified primary reviewers who read the full set of articles, and the remaining HSP Committee members were responsible for reviewing several articles each. The reviewers considered both content and methodology as well as whether there was balanced reporting and adherence to HSP Committee processes. All reviewers were vetted through the same conflict of interest disclosure and management process as described in the "Description of Methods Used to Formulate the Recommendations" field. Finally, the Editor in Chief of *CHEST* read and forwarded the manuscripts for independent, external peer review prior to acceptance for publication. No recommendations or assessments of the quality of the evidence could be changed without the express approval of the topic panel members, AT9 Executive Committee, HSP Committee, and ACCP Board of Regents.

This guideline is endorsed by the American Association for Clinical Chemistry, the American College of Clinical Pharmacy, the American Society of Health-System Pharmacists, the American Society of Hematology, and the International Society on Thrombosis and Haemostasis.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Appropriate monitoring and management of patients who require perioperative treatment with antithrombotic therapy

Potential Harms

- Administration of antithrombotic drugs may induce bleeding complications.
- Interruption of antithrombotic therapy carries the risk of perioperative thromboembolism.
- In one study, patients requiring intracranial or prostate surgery did have an increase in bleeding with perioperative acetylsalicylic acid (ASA) continuation, and in such patients (and others deemed at high risk for bleeding), perioperative continuation of ASA should be considered with caution.

Qualifying Statements

Qualifying Statements

- The evidence-based practice guidelines published by The American College of Chest Physicians ("ACCP") incorporate data obtained from a comprehensive and systematic literature review of the most recent studies available at the time. Guidelines are intended for general information only, are not medical advice, and do not replace professional medical care and physician advice, which always should be sought for any specific condition. Furthermore, guidelines may not be complete or accurate because new studies that have been published too late in the process of guideline development or after publication are not incorporated into any particular guideline before it is disseminated. The ACCP and its officers, regents, governors, executive committee, members and employees (the "ACCP Parties") disclaim all liability for the accuracy or completeness of a guideline, and disclaim all warranties, express or implied. Guideline users always are urged to seek out newer information that might impact the diagnostic and treatment recommendations contained within a guideline. The ACCP Parties further disclaim all liability for any damages whatsoever (including, without limitation, direct, indirect, incidental, punitive, or consequential damages) arising out of the use, inability to use, or the results of use of a guideline, any references used in a guideline, or the materials, information, or procedures contained in a guideline, based on any legal theory whatsoever and whether or not there was advice of the possibility of such damages.
- Through a comprehensive and systematic literature review, the ACCP's evidence-based clinical practice guidelines incorporate data from the existing peer-reviewed literature. This literature meets the prespecified inclusion criteria for the clinical research question, which ACCP considers, at the time of publication, to be the best evidence available for general clinical information purposes. This evidence is of varying quality from original studies of varying methodological rigor. The ACCP recommends that performance measures for quality improvement, performance-based reimbursement, and public reporting purposes should be based on rigorously developed guideline recommendations. However, not all recommendations graded highly according to the ACCP grading system (1A, 1B) are necessarily appropriate for development into such performance measures, and each one should be analyzed individually for importance, feasibility, usability, and scientific acceptability (National Quality Forum criteria). Performance measures developers should exercise caution in basing measures on recommendations that are graded 1C, 2A, 2B, and 2C, according to the ACCP Grading System as these should generally not be used in performance measures for quality improvement, performance-based reimbursement, and public reporting purposes.
- Limitations of Methods: Although encouraged to use Evidence Profiles and Summary of Findings tables for all recommendations, there were some for which the authors were unable to produce such tables. However, those recommendations used an evidence-based systematic review and assessment of relevant studies. Some recommendations would have benefited from meta-analyses that would have clarified aspects of the evidence. Although panelists were instructed in completing the value and preference rating exercise to estimate patient values and preferences rather than to use their own, it cannot be assured that they succeeded in all instances.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Quick Reference Guides/Physician Guides

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

Living with Illness

Staying Healthy

IOM Domain

Effectiveness

Safety

Identifying Information and Availability

Bibliographic Source(s)

Douketis JD, Spyropoulos AC, Spencer FA, Mayr M, Jaffer AK, Eckman MH, Dunn AS, Kunz R. Perioperative management of antithrombotic therapy: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest. 2012 Feb;141(2 Suppl):e326S-50S. [219 references] PubMed

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2008 Jun (revised 2012 Feb)

Guideline Developer(s)

American College of Chest Physicians - Medical Specialty Society

Source(s) of Funding

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The sponsors played no role in the development of these guidelines. Sponsoring organizations cannot recommend panelists or topics, nor are they allowed prepublication access to the manuscripts and recommendations.

Guideline Committee

American College of Chest Physicians Antithrombotic Therapy and Prevention of Thrombosis Panel

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Financial Disclosures/Conflicts of Interest

All panelists were required to disclose both financial conflicts of interest, such as receipt of funds for consulting with industry, and intellectual conflicts of interest, such as publication of original data bearing directly on a recommendation. Financial and intellectual conflicts of interest were classified as primary (more serious) or secondary (less serious). The operational definition of primary intellectual conflicts of interest included authorship of original studies and peer-reviewed grant funding (government, not-for-profit organizations) directly bearing on a recommendation. The operational definition of primary financial conflicts of interest included consultancies, advisory board membership, and the like from industry. Topic editors had no primary conflicts of interest, as noted. Some deputy editors, who were clinical experts in the topic of the article, had relevant primary conflicts of interest. The American College of Chest Physicians (ACCP) Health and Science Policy (HSP) Committee deemed some of these conflicts serious enough to require "management." Management involved more frequent updates of disclosures than required of the approved panelists without any conflicts and recusal from activities relevant to that conflict.

Topic panel members, including the deputy editor, with primary conflicts related to a particular recommendation did not participate in the final deliberations that led to the decision regarding the direction or strength of a recommendation, nor did they vote on recommendations for which they were primarily conflicted. Panelists with primary conflicts could, however, participate in discussions and offer their opinions on interpretations of the evidence. Readers will find a record of panelist conflicts of interest on a recommendation-by-recommendation basis in the online data supplement.

In summary, the authors have reported to *CHEST* the following conflicts of interest: Dr Douketis was a consultant for Boehringer Ingelheim and served as a consultant during four advisory board meetings (by Sanofi-Aventis, AstraZeneca, Boehringer Ingelheim, Pfizer) relating to the development and clinical use of novel, but not approved for clinical use, antiplatelet drugs (ticagrelor) and anticoagulant drugs (apixaban, semuloparin, dabigatran). Dr Eckman has received the following university grants: "Using Decision Analytic Modeling to Guide the ACCP Guideline Development Process for Antithrombotic Therapy in Atrial Fibrillation" (Foundation for Informed Medical Decision Making; October 2011-September 2013; $185,000); "Cost-Effectiveness of Screening for Chronic Hepatitis C Infection" (Merck/Schering-Plough; October 2011-September 2012; $58,000); "Greater Cincinnati BEACON Collaborative" (Office of the National Coordinator for Health Information Technology [90BC0016/01]; September 2010-March 2012; ~15% effort); "Cincinnati Center for Clinical and Translational Science and Training (CTSA) ARRA Supplement for Development of Distance Learning Program in Medical Informatics" (National Institutes of Health [NIH]/National Center for Research Resources [NCRR] [UL1 RR026314-01S1]; August 2009-August 2011; ~20% effort); "Cincinnati Center for Clinical and Translational Science and Training (CTSA)" (NIH/NCRR [1U54 RR 025216]; January 2009-February 2014; ~15% effort); "A Patient Specific Decision Support Tool for Bariatric Surgery" (National Institute of Diabetes and Digestive and Kidney Diseases [K23 DK075599]; August 2007-June 2012; no financial support); National Heart, Lung, and Blood Institute (K23 HL085387; June 2008-March 2013; no financial support); and "Cost-Effectiveness of Screening for Chronic Hepatitis B Infection" (Gilead Sciences Inc; March 2008-August 2010; ~$56,000). He has also served as consultant for Savient Pharmaceuticals ("Cost Effectiveness Analysis of Gout Medication"; 2010; ~$300) and as editorial consultant for the ACP ("Physicians' Information and Education Resource [PIER]: Module on Pre-Operative Assessment for Bleeding Disorders"; 2006-present; ~$250/year). Dr Spyropoulos has served as a consultant to Pfizer, Sanofi-Aventis, and EISAI. Dr Jaffer served as a consultant to sanofi-aventis, Janssen, Canyon Pharmaceuticals, Boehringer Ingelheim, and Daiichi Sankyo; he has formerly spoken on behalf of sanofi-aventis. Dr Jaffer is also on the steering committee of an NHLBI clinical trial. Dr Kunz is a member of the GRADE Working Group, the methodology of which is used in these guidelines. She has an interest in seeing this methodology applied. Drs Spencer, Mayr, and Dunn have reported that no potential conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.

Guideline panel members, including the chair, and members of the Health & Science Policy Committee are blinded to the funding sources. Further details on the Conflict of Interest Policy are available online at http://chestnet.org.

Guideline Endorser(s)

American Association for Clinical Chemistry, Inc. - Professional Association

American College of Clinical Pharmacy - Medical Specialty Society

American Society of Health-System Pharmacists - Professional Association

American Society of Hematology - Medical Specialty Society

International Society on Thrombosis and Haemostasis - Professional Association

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Douketis JD, Berger PB, Dunn AS, Jaffer AK, Spyropoulos AC, Becker RC, Ansell J. The perioperative management of antithrombotic therapy: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). Chest 2008 Jun;133(6 Suppl):299S-339S. [237 references]

Guideline Availability

Electronic copies: Available to subscribers of Chest - The Cardiopulmonary and Critical Care Journal.

Print copies: Available from the American College of Chest Physicians, Products and Registration Division, 3300 Dundee Road, Northbrook IL 60062-2348.

Availability of Companion Documents

The following are available:

- Executive summary: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2012;141;7S-47S.
- Introduction to the ninth edition: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical guidelines. Chest 2012;141;48S-52S.
- Methodology for the development of antithrombotic therapy and prevention of thrombosis guidelines: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2012;141;53S-70S.
- Patient values and preferences in decision making for antithrombotic therapy: a systematic review: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2012;141;e1S-e23S.
- Oral anticoagulant therapy: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2012;141;e44S-e88S.
- Antiplatelet drugs: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2012;141;e89S-e119S.
- New antithrombotic drugs: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2012;141;e120S-e151S.
- Approach to outcome measurement in the prevention of thrombosis in surgical and medical patients: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2012;141;e185S-e194S.

Electronic copies: Available to subscribers of Chest - The Cardiopulmonary and Critical Care Journal.

Print copies: Available from the American College of Chest Physicians, Products and Registration Division, 3300 Dundee Road, Northbrook IL 60062-2348.

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on December 3, 2008. The information was verified by the guideline developer on January 7, 2009. This summary was updated by ECRI Institute on January 5, 2010 following the U.S. Food and Drug Administration advisory on Plavix (Clopidogrel). This summary was updated by ECRI Institute on May 17, 2010 following the U.S. Food and Drug Administration advisory on Plavix (clopidogrel). This summary was updated by ECRI Institute on July 27, 2010 following the FDA drug safety communication on Heparin. This NGC summary was updated by ECRI Institute on May 2, 2012. This summary was updated by ECRI Institute on March 10, 2014 following the U.S. Food and Drug Administration advisory on Low Molecular Weight Heparins.

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